GEOBOTANICAL COMPARISON BETWEEN TWO JAPANESE VOLCANOES: MT. FUJI AND MT. ASAMA

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Abstract - Mt. Fuji and Mt. Asama are two of the highest Japanese volcanoes, reaching 3776 and 2542 m a.s.l. respectively. The former is dormant but the latter is an active volcano. This study is based on our own unpublished data, which includes a total of 152 phytosociological relevés, and on previous studies of the vegetation of both volcanoes. On the basis of the data collected at different times a geobotanical comparison between the two volcanoes as regards their high mountain regions was made. In this region the following belts may be distinguished on both volcanoes:

- a subalpine belt, characterized on its upper zone by shrub communities with some *Ericaceae*, larch (*Larix leptolepis*), *Salix reinii* and other dwarf woody species;
- an alpine belt, where there is scattered herbaceous vegetation, mostly dominated by *Polygonum weyrichii* v. *alpinum*. In this belt on Mt. Fuji, the following communities may be distinguished: the *Arabis serrata-Polygonum alpinum* community on the lowest altitudes; the *Stellaria nipponica-Polygonum alpinum* community and at higher altitudes a very sparse poor community characterized by *Cassiope lycopodioides*. In the highest region up to the summit there are moss and lichen communities only. On the southeastern side on the 1707 ash and scoria there is pioneer vegetation dominated by *Cirsium purpuratum* and *Campanula hondoensis*.

On Mt. Asama the high-mountain vegetation is dominated by the *Polygonum alpinum* community. It occupies a narrower belt. Here the volcanic activity doesn't allow the vegetation to reach the top. In the highest region of the volcano there is a bare sterile zone. The differences found in the altitudinal distribution of vegetation on the two volcanoes can partly be attributed to the fact that one (Mt. Fuji) is dormant, while the other (Mt. Asama) is active. On active volcanoes the ecological factors related to the volcanic activity have a strong influence on the vegetation and its distribution.

Key words – high Japanese volcanoes, high mountain vegetation, dormant and active volcanoes

Introduction

In volcanic areas, among the ecological factors operating, there are those closely related to the volcanic activity. These factors greatly condition the plant life, its development and its distribution. (see Taylor, 1957; Yoshioka, 1966; Poli, 1970b;

1970-71; Smathers & Müller-Dombois, 1974; Nakamura, 1985; Raus, 1986; Mazzoleni *et al.* 1989; Whittaker *et al.* 1989; Tsuyuzaki, 1991; Bernjanson, 1991; del Moral & Wood, 1993; Kitayama *et al.* 1995 and others). This is the reason for the great interest in volcanoes from a geobotanical point of view. One of the phenomena that have made it possible to point out the relationship between factors connected with the volcanic activity and the vegetation is the altitudinal distribution of vegetation on volcanic mountains (see Poli, 1965; 1974; 1996; Ohsawa *et al.* 1971; Ohsawa, 1984; Masuzawa, 1985).

This study examines the vegetation and its altitudinal distribution on the high mountain region of two of the highest Eastern Asiatic volcanoes: Mt. Fuji and Mt. Asama, of which the former is dormant and the latter active. The aim is to point out some of the main relationships existing between volcanic activity and plant cover. To this end a geobotanical comparison between the two volcanoes has been made. It is based on a lot of our own unpublished data and on previous studies (Poli, 1964; 1970a; 1974; 1996; Miyawaki *et al.* 1967; 1969; 1971).

PHYSIOGRAPHY

Mt. Fuji and Mt. Asama are two high Japanese volcanoes, with a height of 3776 m and 2542 m a.s.l. respectively. The former is a dormant volcano while the latter is active. Both are located on the Honshu island in areas not very far from one another.

Mount Fuji is located at 35° 21' N, at a short distance from the Pacific coast (about 100 km south-west of Tokyo). It is considered a dormant volcano since its last eruption occurred in 1707. Fuji was formed as a result of chiefly explosive activity and stands almost completely on a Miocenic volcanic platform, which is about 1600 m high. A small part of this base is made up of Pliocene sediments. On its northern side the volcanic structure stands on the Komitake strato-volcano, probably originally of the Pleistocene era, but almost completely covered by more recent materials. According to recent opinion, the new volcano is made up of two volcanoes one upon the other: Old Fuji and the present Fuji. The latter is thought to be a strato-volcano mainly composed of ejecta. These ejecta are olivine-basalts and pyroxene-olivine-basalts (Tsuya, 1955; 1962; 1971).

The climate on Fuji is characterised by high rainfall in summer (June-September); it is rather dry in winter (Yamamoto, 1971). The annual rainfall at elevations of 1700 m and 2500 m is estimated to be 2250 and 2500 mm respectively (see Nakamura 1984); the temperature reaches an annual mean of 5.2° C and 0.7° C respectively, while at the top there is a mean annual temperature of -6,4° C, with negative values for 9 months (October-June).

Mount Asama, on the boundary between the Nagano and Gumma Prefectures, ranks as one of the two most active volcanoes in Japan, equalled only by M. Aso, in Kyûshû. About 2000 eruptions were recorded in the period between 1933 and 1960. Mt Asama belongs to the volcanic system "Nasu" in northern Japan; it is the most recent volcano in this system. It stands on a high plain of about 100 m made up of Miocene and Pleistocene sediments and volcanic rocks, of lacustral deposits of the Pliocene-Pleistocene period and of rocks from previous Pleistocene volcanoes. Mt. Asama is to be considered (Kuno 1962) an andesitic strato-volcano with a false double crater formed on a shield volcano, which in its turn stands on an old strato-volcano. It is a question therefore of a volcano made up of three superimposed structures which were formed in different periods.

There are no meteorological stations on the high mountain region of Mt. Asama. The climatic data collected (see Poli, 1970a) at three stations located at altitudes between 934 and 1264 m a.s.l. show that the rainfall reaches an annual mean between 1150 and 1380 mm, with the highest values in the summer period; there isn't any really dry period. The temperature reaches an annual mean between 6,4°C and 8,8°C. The average monthly temperature drops to -9° C and -10° C in the winter months and reaches a maximum of about 20°C in the month of August.

METHOD

The field survey on the two volcanoes was carried out at different times in the region located between the forest limit and the summit, on different sides and along an altitudinal gradient. During the field trips, 152 phytosociological relevés were made. The locations were chosen so that the main variations in vegetation types were sampled. In all locations floristic relevés between 30 and 100 sq.m., were made and the cover-dominance (c-d) and the sociability (s) of every vascular plant species was estimated using Braun-Blanquet's scale (c-d: +, very sparsely present; 1, < 10%; 2, 10-25 %; 3, 25-50%; 4, 50-75%; 5, 75-100%; s: 1, single individuals; 2, grouped; 3, in troops; 4, in small colonies; 5, in big populations). The phytosociological tables make it possible to point out the plant communities present on each volcano. Some of the collected data had been utilised in our previous studies (Poli 1964, 1970a, 1974, 1996) and the phytosociological study of the high mountain vegetation of Mt. Fuji will be the subject of another paper.

The analysis carried out has provided useful information for a geobotanical comparison between the two volcanoes. It is based on all our data together with others drawn from the literature (Miyawaki *et al.* 1967; 1969; 1971). To indicate the floristic composition of the vegetation, significant relevés have been selected and arranged in synthetic tables, where for each community only the constancy class is given. Some site data and the main physiognomic characteristics of the vegetation are presented in a synoptic table.

The nomenclature for vascular plants follows Ohwi (1953).

RESULTS

In the high mountain area above the limit of the forest, on both volcanoes two different vegetation belts may be distinguished: the subalpine and the alpine belt respectively. The terms alpine and subalpine are used here with the wide meanings given to them by various Japanese authors (Hayata, 1911; 1926; Miyawaki *et al.* 1967; 1969; 1971; Ohsawa *et al.* 1971, Nakamura & Obata 1982; Ohsawa, 1984, Nakamura, 1985 and others).

SUBALPINE BELT

On Fuji this belt is between 1600-1700 and 2400-2500 m. At lower elevations there are types of forest vegetation dominated by *Tsuga diversifolia, Abies veitchii Abies mariesii, Larix leptolepis* and deciduous broadleaved trees. The upper subalpine belt is dominated by low shrub communities characterized by some dwarf woody species such as *Salix reinii* and *Alnus maximowiczii, Betula ermanii* var. *japonica* and some Rosaceae and Ericaceae (Tab 1). Dwarf larch woodlands (*Larix leptolepis* communities) and isolated dwarf larches are to be found at altitudes of up to 2700-2800 m. These shrublands do not form a continuous belt and they are denser on the rocky slopes, where they can reach up to 2800 m.

TABLE 1 - BETULA ERMANII - LARIX LEPTOLEPIS COMMUNITY

	Poli unpubl.
number relevés	5
Betula ermanii Cham. v. japonica (Shirai) Koidz	V
Larix leptolepis (Sieb.et Zucc.) Gordon	IV
Salix reinii Fr. et Sav.	V
Vaccinium vitis-idaea L.	V
Alnus maximowiczii Callier.	IV
Solidago virga-aurea L. v. leiocarpa (Benth.) Miq.	IV
Saussurea triptera Maxim.	III
Clematis ochotensis (Pall.) Poir.	III
Fragraria nipponica Makino	III
Rhododendron brachycarpum D. Don.	III
Abies veitchii Lindl.	II
Festuca ovina L.	II
Trientalis europaea L.	II
Pyrola alpina H. Andres	II
Pyrola incarnata Fisch.	II
Hedysarum vicioides Turcz.	II
Calamagrostis langsdorffii (Link) Trin.	II
Polygonum cuspidatum Sieb. et Zucc.	II
Cacalia hastata L. v. farfaraefolia (Maxim.) Ohwi	II
Streptopus streptopoides (Ledeb.) Frye et Rigg. v. japonicus (Maxim.) Fasset.	I
Pternopetalum tanakae (Fr. et Sav.) Hand. Mazz.	I
Miscanthus oligostachyus Stapf.	I

On the mobile and unstable crumbly stony surfaces between the rocky slopes there are communities dominated by *Polygonum weyrichii* v. *alpinum* and by *Polygonum cuspidatum*, both of which species, especially the former, are widespread in the alpine belt.

On Mt. Asama the forest limit, characterized also here by *Larix leptolepis* communities, is at about 1950-2000 m (Poli, 1970a). The subalpine belt bere extends from this limit up to about 2150 m. The upper zone of this belt is characterized by a dwarf shrub vegetation often dominated by evergreen Ericaceae and dwarf *Salix reinii* with bowed branches. A very common community is that dominated by *Salix reinii* (Table 2). Less frequently, near the lower altitudinal limit of the belt there are woody species like *Larix leptolepis*, *Alnus maximowiczii* and *Sorbus commixta*.

TABLE 2 - SALIX RENII COMMUNITY

	Poli 1970	
number relevés	2	7
Salix reinii Fr. et Sav.	3	V
Deschampsia flexuosa Trin.	3	V
Polygonum cuspidatum Sieb. et Zucc.	2	V
Vaccinium uliginosum L.	3	III
Differ. species of variants		
Empetrum nigrum L. v. japonicum K. Koch	2	
Loiseleuria procumbens Desf.	2	
Vaccinium vitis-idaea L.	2	
Carex oxyandra (Fr. et Sav.) Kudo	2	
Polygonum weyrichii F. Schmidt v. alpinum Maxim.		V
Other species		
Shortia soldanelloides (Sieb. Et Zucc.) Makino	1	I
Anaphalis margaritacea (L.) Benth.et Hook.	1	

Within the *Salix reinii* community two diffcrent types may be distinguished. The first is characterized by some species of Ericaceae. As the altitude increases the Ericaceae, of which the last is *Vaccinium uliginosum*, disappear and *Polygonum weyrichii* v. *alpinum* becomes more frequent; *Polygonum cuspidatum* is to be found on the same substrates but not at high altitudes (Poli, 1970a). The second vegetation type is distinguished by the absence of Ericaceae and by the constant presence of *Polygonum weyrichii* v. *alpinum*. This shows the gradual change in vegetation distribution towards the higher elevations.

ALPINE BELT

This belt is characterized by vegetation that is very poor in species. It is dominated by scattered perennial herbs which decrease in coverage as the altitude increases. On both volcanoes, the most significant species of this vegetation is *Polygonum weyrichii* v. *alpinum* which is able to colonize the mobile and unstable substrates found in many areas of this belt.

On Mt. Fuji the communities listed below may be distinguished within this belt.

- A community (Tab. 3) characterized by *Arabis serrata* and *Polygonum weyrichii* v. *alpinum* (*Arabido-Polygonetum alpini* Miyawaki *et al.* 1971). It is able to settle in the mobile substrates of wide areas located at elevations between 2450 and 2800 m and above. At the lowest elevations some woody dwarf species of the subalpine belt (*Larix leptolepis, Salix reinii* and others) are present.

TABLE 3 - ARABIS SERRATA - POLIGONUM COMMUNITY

	Poli unpubl.
number relevés	30
Arabis serrata Fr.et Sav.	V
Polygonum weyrichii F. Schmidt v. alpinum Maxim.	V
Artemisia pedunculosa Miq.	V
Stellaria nipponica Ohwi	IV
Carex stenantha Fr. Et Sav.	III
Salix reinii Fr. et Sav.	III
Polygonum cuspidatum Sieb. et Zucc.	II
Carex doenitzii Boecklr	II
Astragalus adsurgens Pall.	II
Betula ermanii Cham. v. japonica (Shirai) Koidz	I
Larix leptolepis (Sieb.et Zucc.) Gordon	I
Musci and Lichenes sp. pl.	III
Hedysarum vicioides Turcz.	I
Cassiope lycopodioides (Pall.) D. Don	I
Alnus maximowiczii Callier.	I

- On the south-eastern side, on volcanic ash and scoria produced by the latest eruption (1707) of the Hoei parasitic volcano (2702 m), some types of very poor pioneer vegetation are widespread. They are present below 2300 m and can be found at altitudes as low as 1440 m. The main vegetation type (Tab. 4) is characterized by *Cirsium purpuratum* and *Campanula hondoensis* (*Cirsio-Campanuletum hondoensis* Miyawaki *et al.*1971). In the earliest stage of this vegetation type *Campanula* *hondoensis* is not represented (Tab. 5) while *Polygonum weyrichii* v. *alpinum* occurs frequently. In some sites it is the only colonizer species.

TABLE 4 - CIRSIUM PURPURATUM - CAMPANULA HONDOENSIS COMMUNITY

	Poli unpubl.	Miyawaki 1971
number relevés	2	10
Cirsium purpuratum (Maxim.) Matsum.	2	V
Campanula punctata Lam. v. hondoensis (Kitam.) Ohwi	2	V
Polygonum cuspidatum Sieb. et Zucc.	2	V
Calamagrostis hakonensis Fr. et Sav.	2	V
Arabis serrata Fr.et Sav.	1	V
Artemisia pedunculosa Miq.	1	V
Polygonum weyrichii F. Schmidt v. alpinum Maxim.	1	IV
Salix reinii Fr. et Sav.	1	III
Hedysarum vicioides Turcz.	1	II
Astragalus adsurgens Pall.		IV
Stellaria nipponica Ohwi		II
Miscanthus oligostachyus Stapf.	2	
Aster ageratoides Turcz. v. ovatus (Fr. et Sav.) Nakai	2	
Anaphalis margaritacea (L.) Benth.et Hook.	1	
Senecio nemorensis L.	1	
Picris hieracioides L. ssp. japonica (Thunb.) Krylov	1	

TABLE 5 - CIRSIUM PURPURATUM - POLYGONUM COMMUNITY

	Poli unpubl.	Miyawaki 1971
number relevés	5	20
Polygonum weyrichii F. Schmidt v. alpinum Maxim.	V	V
Cirsium purpuratum (Maxim.) Matsum.	IV	V
Polygonum cuspidatum Sieb. et Zucc.	III	V
Arabis serrata Fr.et Sav.	II	III
Astragalus adsurgens Pall.	III	I
Artemisia pedunculosa Miq.	II	I
Salix reinii Fr. et Sav.	I	I
Musci and Lichenes sp. pl.	V	
Calamagrostis hakonensis Fr. et Sav.		I
Stellaria nipponica Ohwi		I

- Above 2900 m up to about 3350 m the vegetation becomes even poorer. The *Arabis serrata -Polygonum alpinum* community is no longer recognizable in that the *Arabis serrata* and some other species disappear. There is a pioneer vegetation made up of a very few species and characterized (Tab. 6) by *Stellaria nipponica* and *Polygonum alpinum* (*Stellaria nipponica-Polygonum alpinum* community). Here mosses and lichens are frequent.

TABLE 6 - STELLARIA NIPPONICA - POLYGONUM ALPINUM COMMUNITY

	Poli unpubl.
number relevés	14
Polygonum weyrichii F. Schmidt v. alpinum Maxim.	V
Stellaria nipponica Ohwi	IV
Musci and Lichenes sp. pl.	IV
Carex stenantha Fr. Et Sav.	III
Carex doenitzii Boecklr	I
Arabis serrata Fr.et Sav.	I
Salix reinii Fr. et Sav.	I

- At higher altitudes up to 3500-3540 m there are very few species, which are often located in the rocky cavities. *Cassiope lycopodioides* is the most frequent species and *Carex stenantha* and *Stellaria nipponica* as well as mosses and lichens occur often (*Cassiope lycopodioides* community - Tab. 7). In some sites, at about 2800 m, *Phyllodoce nipponica* is often to be found with *Cassiope lycopodioides* (*Cassiope lycopodioides-Phyllodoce nipponica* community Miyawaki et al. 1971). Single individuals of this species can reach 2990 m (Poli, 1974).

TABLE 7 - CASSIOPE LYCOPODIOIDES COMMUNITY

	Poli unpubl.	Miyawaki 1971
number relevés	7	11
Cassiope lycopodioides (Pall.) D. Don	V	IV
Phyllodoce nipponica Makino	II	IV
Carex stenantha Fr. Et Sav.	V	II
Polygonum weyrichii F. Schmidt v. alpinum Maxin	II	I
Betula ermanii Cham. v. japonica (Shirai) Koidz	I	II
Musci and Lichenes sp. pl.	V	
Stellaria nipponica Ohwi	III	
Salix reinii Fr. et Sav.		II
Festuca ovina L.	I	
Shortia soldanelloides (Sieb. Et Zucc.) Makino		I

Above the upper limit of the vascular plants, which reaches a maximum elevation of 3610 m a.s.l. (Poli, 1974), and up to the summit (3776 m) there are only mosses and lichens. The mosses are represented by the species: *Pogonatum urnigerum* (Hedw.) P. Beauv., *Polytrichum piliferum* Schreb. and other *Polytrichum* species, *Ceratodon purpureus* (Hedw.) Brid., *Hypnum plicatulum* Schl., *Arctoa fulvella* (Dicks.) B., *Dicranum rugosum* Brid., *D. fuscescens* Tum., *Racomitrium lanuginosum* (Hedw.) Brid., *R. microcarpum* Brid., *Brium argenteum* Hedw. *Pohlia cruda* (Hedw.) Lindb. and other *Pohlia* species. The lichens are represented by the species: *Rhizocarpon geographicum* (L.) DC., *Stereocaulon vesuvianum* Pers., *Umbilicaria leiocarpa* (Lam.) Steud., *Alectoria alata* (Tayl.) Linds. Often they are organised into dense colonies and communities: the *Pogonatum urnigerum* community is a very frequent moss community.

Mosses and lichens are well represented at lower altitudes, but in the highest region of the volcano they have a very important role. They are the only plant species able to colonize this region where the hard climatic conditions limit the growth of vascular plants. This is the mosses and lichens zone (see Poli, 1964; 1974). A similar region on the Alps has been called the "thallophyte belt" (Giacomini, 1958).

On Mt. Asama, above 2150-2180 m the trees and the shrubs are replaced by a very poor discontinuous herbaceous vegetation. It is made up of a pioneer community (Tab. 8) characterized by *Polygonum weyrichii* v. *alpinum*; with this species *Deschampsia flexuosa* and *Polygonum cuspidatum* occur most frequently (Poli, 1970a). At the lowest limit of the alpine belt this vegetation includes some shrub species of the subalpine belt like *Salix reinii, Empetrum nigrum, Vaccinium uliginosum.*

TABLE 8 - POLYGONUM ALPINUM COMMUNITY

	Poli 1970
number relevés	8
Polygonum weyrichii F. Schmidt v. alpinum Maxim.	V
Deschampsia flexuosa Trin.	V
Polygonum cuspidatum Sieb. et Zucc.	III
Empetrum nigrum L. v. japonicum K. Koch	I
Salix reinii Fr. et Sav.	I

This vegetation colonizes wide areas covered by ash, scoria, fragments of lava or lapilli. It is widespread up to an elevation of 2380 m a.s.l.. Isolated individuals of *Polygonum weyrichii* v. *alpinum* are to be found on the south-south-eastern slopes at altitudes of up to 2400 m. This is the highest limit for the plant life on this volcano. On the west-north-western slopes the same species is no longer to be found at much lower altitudes: 2280 m, while *Deschampsia flexuosa* stops at 2240 m (Poli, 1970a). This vegetation spreads easily at lower altitudes, on surfaces which have been damaged by the volcanic activity. Here, where it occupies bare substrates, it is rich in species. In this case it is to be considered one of the early stages of primary succession on new volcanic substrates.

On Mt. Asama, as on most active volcanoes (Poli, 1970b; 1970-71), the highest zone up to the summit is completely bare. The volcanic activity, which includes release of gases, explosions with deposits of ejecta and the exit of magma, prevents all form of life from growing for a radius between 200 and 300 m. This is the bare sterile volcanic region.

The main physiognomic characteristics and some site data relating to all the communities indicated above are presented in Table 9. This shows the altitudinal distribution of the vegetation on both volcanoes. Moreover it can be seen that the gradient of the slope may be very high, particularly in the higher areas of Mt. Fuji and that the height of the vegetation becomes lower as the altitude increases. The highest plant cover values are those found for the communities at the highest altitudes, where they succeed in establishing themselves on small surfaces.

TABLE 9 - SITE CHARACTERISTICS; VEGETATION COVER (%) AND VEGETATION HEIGHT (M)

Communities	Authors	Number of relevés	Altitude (m a.s.l.) range	Exposure (main)	Slope (°)	Veget. hight (m) range	Veget.cover (%) range
Mt. Fuji (3776 m)							
1 - Betula ermanii-Larix leptolepis - comm.	Poli unpubl.	5	2220-2710	NO and NE	5-25	h1,00-4,00 0,2-0,7	h40-90 40-90
2 - Arabis serrata-Polygonum alpinum - comm.	Miyaw. et al. 1971 Poli unpubl.	27 30	2100-2950 2180-2880	S, E, S-SE NE and S-SE	10-35 20-40	0,2-0,5 0,2-0,4	5-90 10-35
3 - Stellaria nipponica-Polygonum alpinum - comm.	Poli unpubl.	14	2850-3380	SE and S	20-32	0,15-0,30	5-20
4 - Cassiope lycopodioides - comm.	Miyaw. et al. 1971 Poli unpubl.	11 7	2800-2800 2990-3600	NE N	60-70 20-50	0,05-0,1 0,2-0,25	60-100 20-80
5 - moss, lichen communities above the upper limit of vascular plants	Poli 1974 and unpubl.		3550-3776	all exposures	10-70	0,03-0,05	70-90
6 - Cirsium purpuratum-Campanula hondoensis - comm.	Miyaw. et al. 1971 Poli unpubl.	10 2	1700-2110 1440-1440	E-NE E-NE	10-25 5-10	0,3-0,4 0,2-0,3	3-30 15-55
7 - Cirsium purpuratum-Polygonum alpinum - comm.	Miyaw. et al. 1971 Poli unpubl.	20 5	1900-2420 2100-2280	NEE-E and SE S-SE and SW	5-30 20-35	0,3-0,4 0,20-0,25	3-80 20-25
Mt. Asama (2542 m)							
8 - Salix reinii comm.	Poli 1970	9	1900-2150	SE and S	5-30	0,2-0,5	25-60
9 - Polygonum alpinum comm.	Poli 1970	8	2140-2380	S, SE and W	10-45	0,15-0,50	10-80

• shrub layer

CONCLUSION

The results of this study make it possible to point out both the features the two volcanoes have in common and those in which they differ. They have in common:

- floristic poverty, this being a characteristic arising from the volcanic nature of the soil, as pointed out by various authors for many volcanic areas (see Eggler, 1959; Poli, 1965; Ohsawa *et al.* 1971; Maeda *et al.* 1976 and others);

- a dwarf shrub vegetation dominated by Ericaceae, *Salix reinii* or other woody species on the upper subalpine belt;

- a discontinuous herbaceous vegetation very poor in species dominated by *Polygonum weyrichii* v. *alpinum* on the alpine belt.

Moreover, if only the south-eastern side of Mt. Fuji (the part affected by the 1707 eruption) is considered, on both volcanoes, as on other volcanoes (see Veblen *et al.* 1977), some climatic limits of vegetation are depressed by volcanism. These are the timberline on Mt. Fuji (see Ohsawa 1984) and the upper limit of the alpine vegetation on Mt. Asama.

The two volcanoes differ not only in the different heights they reach but also in that one is dormant and the other active. Relating to this, it should be pointed out that because of the height reached by Mt. Fuji there is an altitudinal belt-like distribution of vegetation that goes above the climatic limit of the vascular plants, with the formation above this limit, as far as the summit, of a horizon of mosses and lichens (Fig.1). The fact that there has been no volcanic activity for a long time has allowed the vegetation to grow and develop undisturbed in space and time. The south-eastern side of the volcano, which was affected by the 1707 eruption is an exception. The lower height of Mt. Asama would permit the *Polygonum alpinum* community to reach the top but the intense volcanic activity in the summit region, which prevents any form of plant life from growing, keeps this community below its altitudinal limit. The highest part of the volcano is, therefore, as stated above, only a bare sterile region.

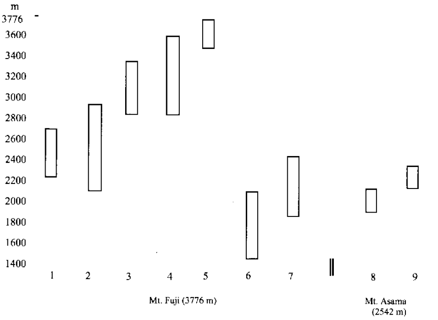

Fig. 1 - Attidudinal distribution of vegetation; the numbers indicaaate the communities (see tab. 9)

To sum up, on Mt Fuji the different belts and horizons follow one another on the slopes of the mountain, giving by their physiognomy a quick survey of the changes in climate. This being so, it is possible to compare Fuji with the Alps and other non-volcanic mountains. On Mt. Asama, on the other hand, the climatic limits of the belts and horizons are disturbed by volcanic activity. This is what has been observed on other active volcanoes such as on some other Japanese volcanoes: Mt. Sakurajima (Tagawa, 1965), Mt. Aso (Poli, 1971), Mt. Tokachi (Poli, unpubl.); on Mt. Etna (Poli, 1964; 1965; 1970-71; 1982; 1996); on volcanoes of south-central Chile (Veblen *et al.* 1977) and on many others.

Riassunto

Sui due alti vulcani giapponesi: Mt. Fuji (3776 m) e Mt. Asama (2542 m) sono state condotte, in tempi diversi, indagini geobotaniche nel corso delle quali sono stati effettuati 152 rilevamenti fitosociologici. In questo lavoro vengono utilizzati, assieme ad altri tratti dalla letteratura, i dati raccolti nella regione più elevata dei due vulcani, quella che si estende dal limite superiore delle foreste fino alla sommità. Scopo è quello di effettuare una comparazione geobotanica tra i due vulcani, limitatamente alla regione di alta montagna. Tale comparazione acquista notevole interesse considerato che il primo dei due vulcani è quiescente, il secondo attivo.

Dopo un breve cenno ai caratteri fisiografici dei due vulcani viene presentata schematicamente la vegetazione che ne caratterizza la porzione più elevata. Essa si distribuisce nei due piani sotto indicati.

a) Piano subalpino, che si estende dal limite superiore delle foreste fino a ca. 2600 e in qualche caso 2800 m. Esso è caratterizzato, nella sua parte più elevata, da formazioni a *Larix leptolepis* e da aggruppamenti basso-arbustivi in cui sono presenti, oltre allo stesso larice, diverse Ericaceae, *Salix reinii* e altre specie legnose.

b) Piano alpino, dal limite superiore dell'orizzonte subalpino fino alla sommità. In esso la vegetazione è molto povera e distribuita discontinuamente. Vi prevale il *Polygonum weyrichii* v. *alpinum*, che sui due vulcani acquista un ruolo molto importante quale specie colonizzatrice dei suoli poveri e sciolti. Sul Mt. Fuji, nella porzione più elevata, oltre il limite della vegetazione dominata dalla citata specie, sono presenti forme di vegetazione molto povere caratterizzate dalla presenza della *Stellaria nipponica* e, più in alto, della *Cassiope lycopodioides*. Ad altitudini più elevate e fino alla sommità è presente un orizzonte caratterizzato solo da musch e licheni, analogamente a quanto è noto per le altre alte montagne. Sul Monte Asama la porzione terminale è dominata dall'intensa attività vulcanica, che impedisce la sopravvivenza ad ogni forma di vita vegetale. Qui, come su ogni vulcano attivo, si viene ad avere una zona completamente sterile.

La comparazione fra i due vulcani, limitatamente alla zona di alta montagna, consente di confermare la singolarità delle aree vulcaniche attive, nelle quali il mondo delle piante è fortemente condizionato dall'attività vulcanica.

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